Managing Total Trihalomethanes with an Aeration System

Ana Verde Tank, Palmdale, California

Background

The use of chlorine to disinfect water produces disinfection byproducts (DBPs) such as total trihalomethanes, haloacetic acids, and chlorite. Total Trihalomethanes (TTHM) is one of the common occurring DBPs formed when naturally occurring organic and inorganic materials in the water react with chlorine and chloramine during disinfection. According to the United State Environmental Protection Agency (USEPA), some people who drink water containing TTHM in excess of the maximum contaminant level (MCL) over many years can experience liver, kidney, or central nervous system problems and increased risk of cancer. As a result, The USEPA developed the Stage 2 Disinfectants and Disinfection Byproducts Rule (DBP Rule) to improve the drinking water standard and provide additional public health protection from DBPs. Under the Stage 2 DBP Rule, the EPA has set the MCL for Total Trihalomethanes at 80 parts per billion (ppb).

With the Stage 2 DBP Rule in place, we were faced with the challenge of meeting the new drinking water standards. In October 2013, we partnered with Medora Corporation to conduct a six-month pilot study focusing on reducing TTHM using an aeration system in a closed environment. The Anaverde tank site, located at the end of the distribution system in Los Angeles County Waterworks District No. 40 Region 34, was chosen for this pilot study. Historically, TTHM levels can be as high as 130 ppb in the summer due to high desert temperatures, and can be as high as 108 ppb in the winter due to reduced demand and subsequent increased water age, especially in areas located at the end of the distribution system. Through this pilot study, we planned to evaluate the effectiveness of a commercialized aeration system and achieve the water quality goal by lowering the TTHM concentration in the tank to below 64 parts per billion (80% of the MCL) in a closed system.

Methodology

The aeration system used for this pilot study consists of the following: one floating spray nozzle with a flow rate of 1 million gallons per day (MGD), one 15 horse power (hp) spray pump, one 2 hp ventilation blower with a flow rate of 750 cubic feet per minute, and one

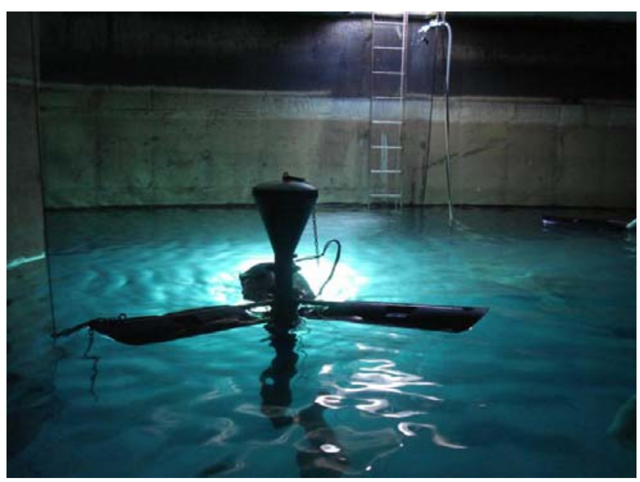

Figure 1: Floating Spray Nozzle TTHM Removal System Inside Tank

submersible mixer. An illustration of the aeration system is shown in Figure 2.

The spray pump draws water from the bottom of the tank as the spray nozzle sprays the water at a 45^{o} downward direction. The intention of the downward spray is to avoid spraying the roof of the tank in order to prevent corrosion of the tank coating. As the water is being sprayed in the air, TTHM gets volatilized into the headspace of the tank. The ventilation blower, located on the top of the tank, blows fresh air into the tank. Subsequently, the volatized TTHM in the air is pushed out of the tank through the tank vent. In order to ensure that the spray nozzle unit is properly working, a pressure transducer was installed inside the spray nozzle. This pressure transducer is able to monitor the pressure in the spray nozzle and determine the flow rate of the water which would allow the operators to make sure that the aeration system is removing TTHMs at an efficient rate. With the SCADA integration, the pressure readings are available to the operators at all times and can be viewed from the field office. In addition, the controls of the entire aeration system were integrated with SCADA. This saves the need for the operator to go to the tank site and physically turn on the aeration system. The submersible mixer at the bottom of the tank can be turned on and off independently from the floating spray nozzle unit. During the time that the TTHM formation potential is low and the operation of the spray nozzle is not needed, the tank mixer can stay on to provide uniformity of the water age and disinfectant residual throughout the tank. Through mixing the water, the need for additional disinfectants, short circuiting of the tanks, and deep cycling of the tanks can all be reduced.

Analysis

In order to conduct this pilot study in a closed environment, the Ana Verde Tank was filled and valved off from the distribution system. Water quality samples were taken on a weekly basis to monitor when the TTHM concentration would peak. Once it was determined that the TTHMs had reached its maximum potential in the tank, the aeration system was started up and daily water quality sampling began. A sample was taken before the aeration system was initially turned on, and once the aeration system was running for four hours, a second sample was taken to see how much TTHM reduction could be achieved in less than a day. We found that the TTHM concentration decreased from 138 ppb to 131 ppb

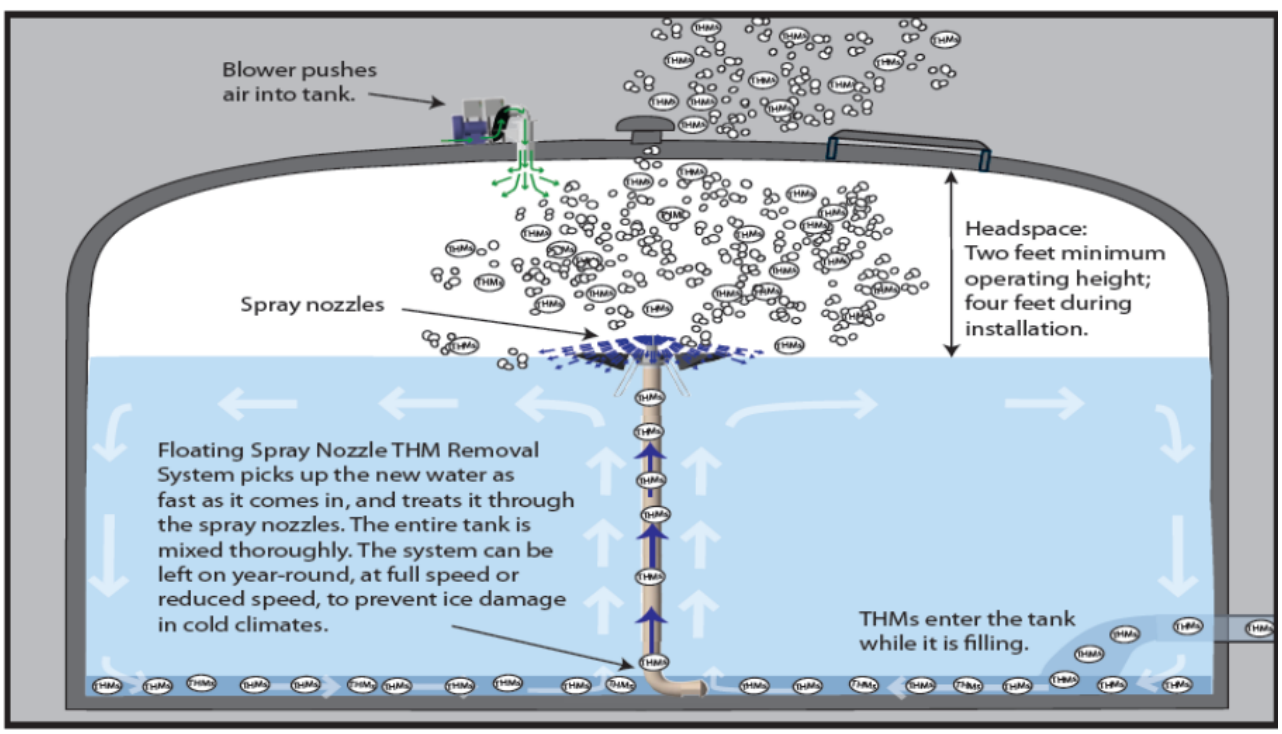

Figure 2: Floating spray nozzle TTHM removal system

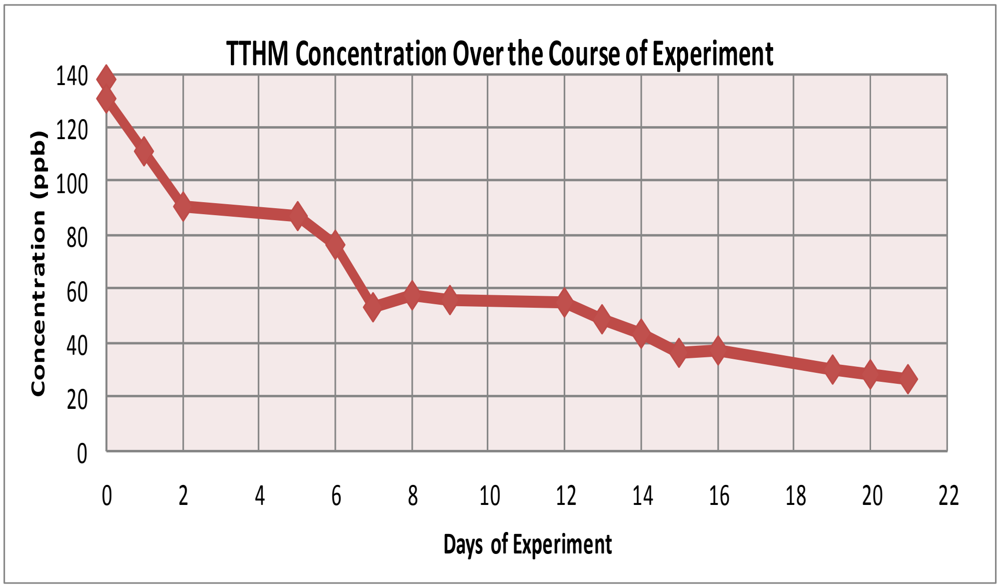

Figure 3: The change in TTHM concentration during the course of the closed system experiment

in the span of these four hours. Daily water quality sampling continued for three weeks after the aeration system was turned on. In the first week, we were able to achieve our goal of a TTHM concentration of less than 64 ppb. After, we continued to operate the aeration system to see how much TTHM reduction could be achieved. During the span of this study, the TTHM concentration reduced from 138 ppb to 28 ppb in 20 days and with a flow rate of 1 MGD, the aeration system was able to aerate the 2.1 MG tank a total of 10 times. The daily TTHM concentrations from this experiment are shown in Figure 3.

Conclusion

The pilot study successfully demonstrated the effectiveness of the aeration system in removing TTHMs in a 2.1 MG drinking water storage tank. With this closed system experiment, we collected water samples for 21 days and monitored the water quality of all the samples taken. We achieved the pilot study water quality goal by reducing TTHM concentration to below 64 ppb in just 7 days when the water was aerated 3.5 times. In conclusion, we found that the aeration system was highly effective with removing TTHMs in a 2.1 MG tank. With these results, we would recommend the use of aeration systems in any other tank facing similar TTHM issues.

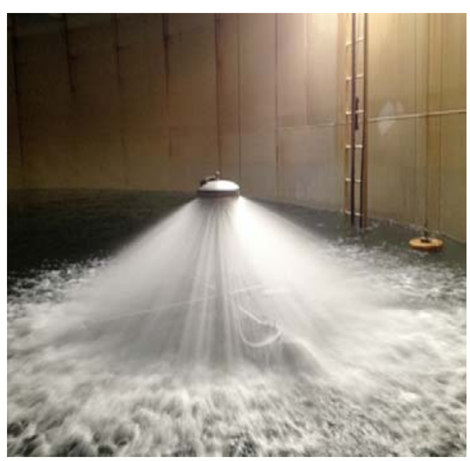

Figure 4: Floating Spray Nozzle TTHM Removal System Operating Inside Tank

Figure 5: Electrical Unit and Blower

We achieved the pilot study water quality goal of less than 64 ppb TTHM concentration in just seven days.

Figure 6: Spray Nozzle